

Responsible Retrofit Guidance Wheel

Adrian Leaman

Development Team:
Isabel Carmona, Peter Cook, Adrian Leaman, Neil May and Tom Randall

Full credits:
Slide 2

Slides 18-30 for use if live web connection is not available

Link:

Credits

The Wheel has been developed with funding and support from the Department of Environment and Climate Change (DECC).

The work has been undertaken by Isabel Carmona, Peter Cook, Adrian Leaman, Neil May, Tom Randall and Caroline Rye under the direction of the STBA project steering group formed by Roger Curtis (Historic Scotland), Sam Allwinkle (CIAT and Napier University), Sofie Pelsmaker (UCL EI) and David Pickles (English Heritage).

During the Wheel's development the following expert group was consulted: Dr Caroline Rye (Walls), Prof Chris Sanders (Roofs), Sofie Pelsmaker (Floors), Dr Paul Baker (Windows and Doors), Diana Hubbard (Chimneys), Nicholas Heath (Heating and Renewables), Ian Mawditt (Ventilation) and Dr Victoria Haynes (People interaction).

The Wheel drew on an approach based on a triage classification developed by Bill Bordass and the Usable Buildings Trust for English Heritage.

www.responsible-retrofit.org/
greenwheel

The Wheel displays ...

1. The geographical context of the retrofit in question.
2. Categories of measures to consider (*fabric, services, behaviour*).
3. Measures in more detail.
4. Different retrofit perspectives (*technical, heritage, energy*).
5. Measure-to-measure linkages.
6. 'Concern' colours.
7. Outcomes and consequences.
8. More detailed information if you need it.
9. With live links to source material with and without paywalls.

All on one interface, to emphasise contextual and systemic nature.

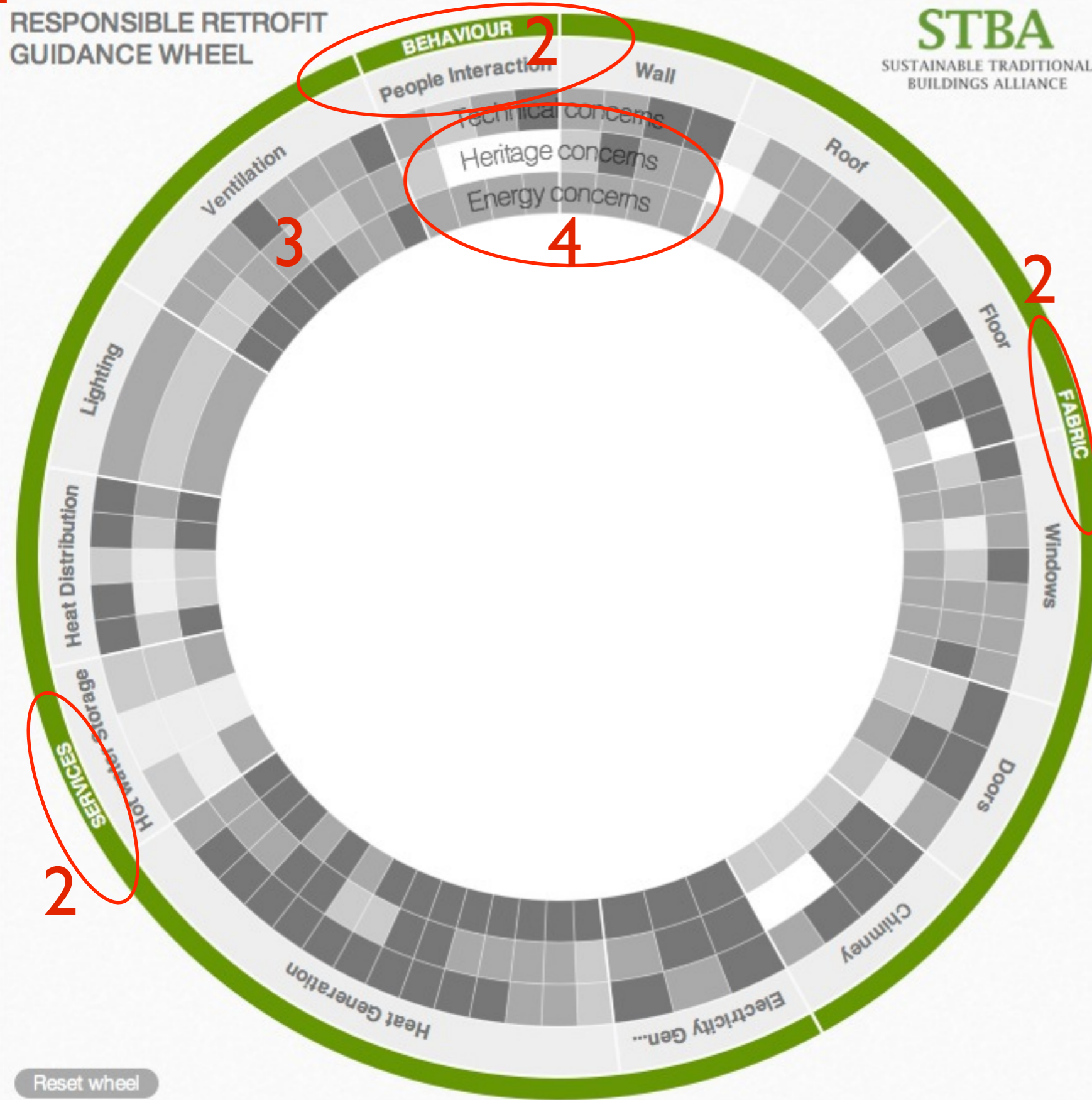
RESPONSIBLE RETROFIT
GUIDANCE WHEEL

GETTING STARTED

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► **Colour key**

▼ ~~Building context~~

Please select the context of your building here:

~~Heritage~~

What is the heritage value of the building?

Conservation area (Building in conservation area)

Condition/State of repair

What is the condition/state of repair of the building?

Fair (Acceptable condition, likely to need some sm

Exposure

What is the exposure of the building to wind driven rain?
(see B.Regs AD C diagram 12 shows map for UK zones).
Apply correction factors if known and as described in BS
8104:1992

Moderate (Wind driven rain (in l/m2 per spell) 33 t

Energy User Type

How does the energy user compares with others in terms to energy use as assessed in the Green Deal Occupancy assessment?

Medium (Typical) Energy Use (Within 20% either side of target)

User interest and involvement In Operation

What is the user's level of motivation and knowledge when operating the building?

Uninterested User

Number of exposed sides

~~How many sides of the building are exposed to wind for ventilation?~~

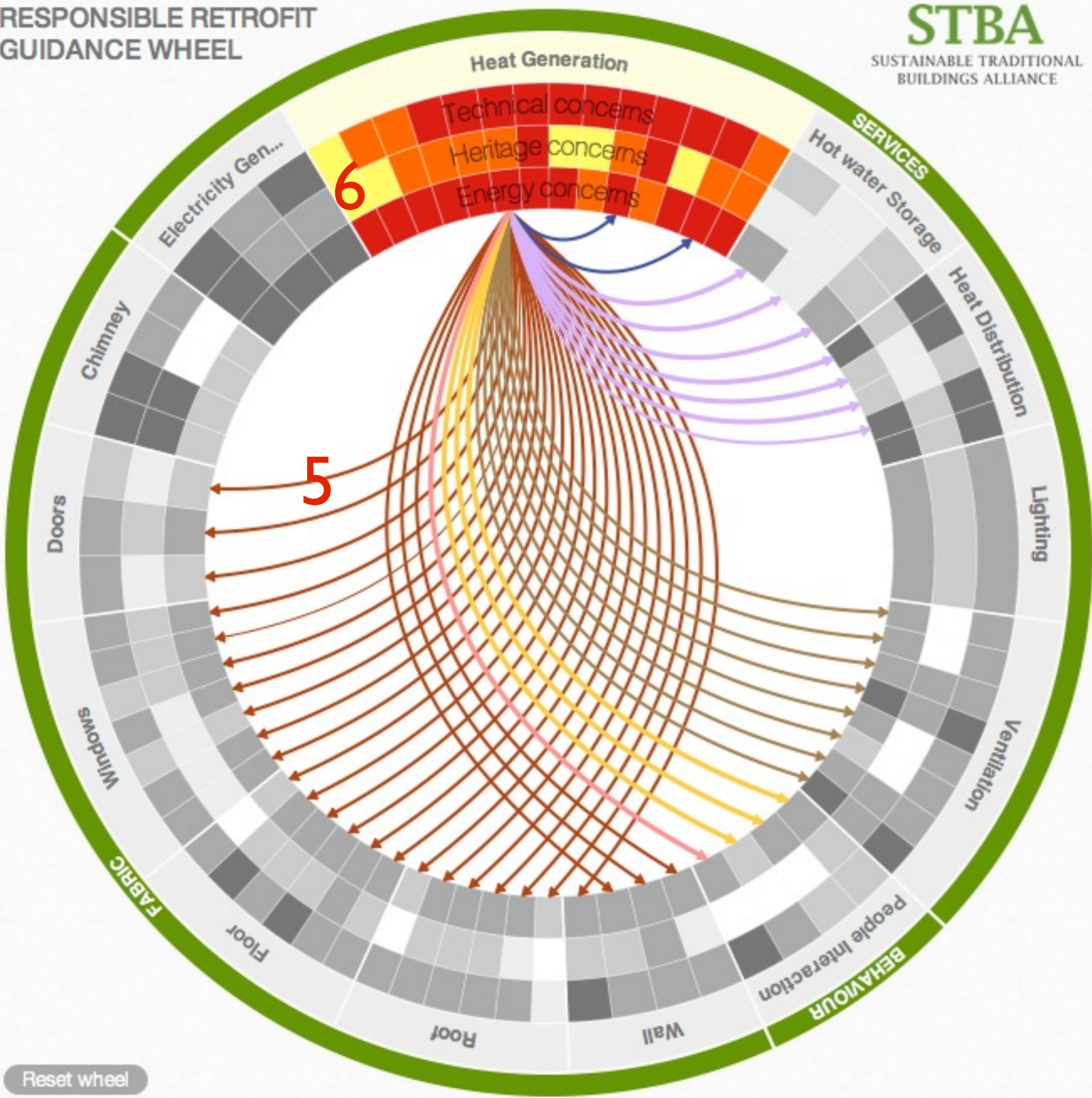
Single (Dwelling has a single exposed side)

Reset wheel

RESPONSIBLE RETROFIT
GUIDANCE WHEEL

STBA
SUSTAINABLE TRADITIONAL
BUILDINGS ALLIANCE

- GETTING STARTED
- ABOUT
- GLOSSARY
- REPORT



► Colour key

► Building context

Heat Generation

Biomass boilers

Installation of large scale biomass boiler (woodchip, woodlogs or pellets) to provide heating and hot water.

- ADD TO LIST
- CLOSE MEASURE

► Advantages

► 7 Technical Concerns

► 3 Heritage Concerns

- Original internal detail lost (high)
- Detail for Access to services (high)
- Detail retains character? (medium)

► 5 Energy Concerns

► Related measures

RESPONSIBLE RETROFIT GUIDANCE WHEEL

STBA

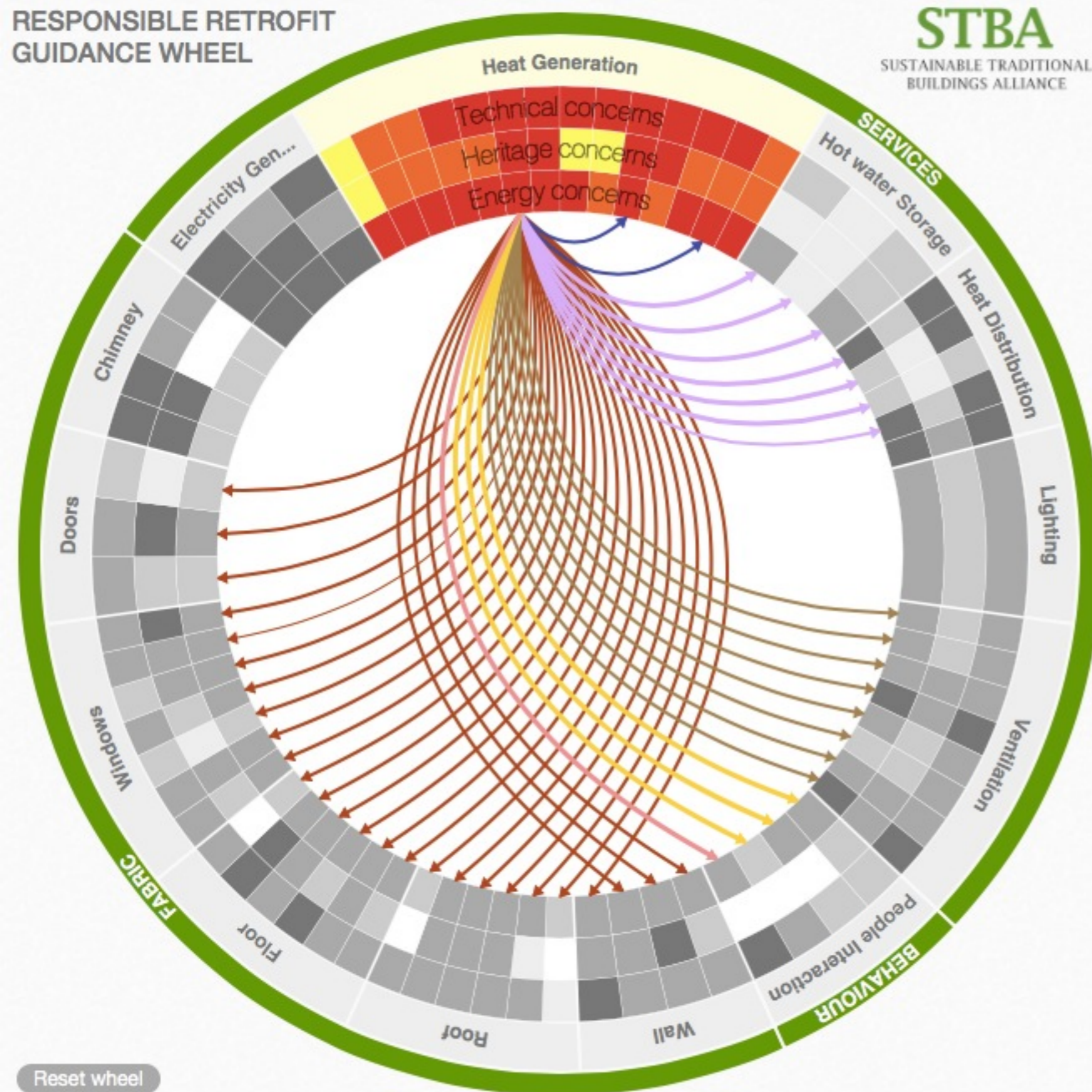
SUSTAINABLE TRADITIONAL BUILDINGS ALLIANCE

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► Colour key

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Installation of large scale biomass boiler (woodchip, woodlogs or pellets) to provide heating and hot water.

ADD TO LIST

CLOSE MEASURE

▼ Advantages

If fuel is truly sustainably sourced this can make very big CO2 savings

▼ 7 Technical Concerns

8

▼ Space limitations (major)

Impact of the measure on the physical space of the building, e.g. reduction of internal areas or doorways through the addition of insulation, or a new piece of equipment which takes up space.

Suggested actions (before)

At design stage, establish impact of measures on space, e.g. insulation thickness; new heating or ventilation system size; new cylinder size

Suggested actions (during)

Check any changes to proposed measures during construction against agreed space requirements and assess whether impact on space increases or decreases.

Suggested actions (after)

Provide feedback about unexpected limitations on space, to manufacturers, suppliers and specifiers for future reference.

References

[CASE STUDY](#) [RESEARCH](#) [Solid Wall Insulation in Scotland: Exploring barriers, solutions and new approaches \(2012\) Chandeworks](#)

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User 'levels'

- Paddling.
- Waist level.
- Full immersion.

www.responsible-retrofit.org/greenwheel

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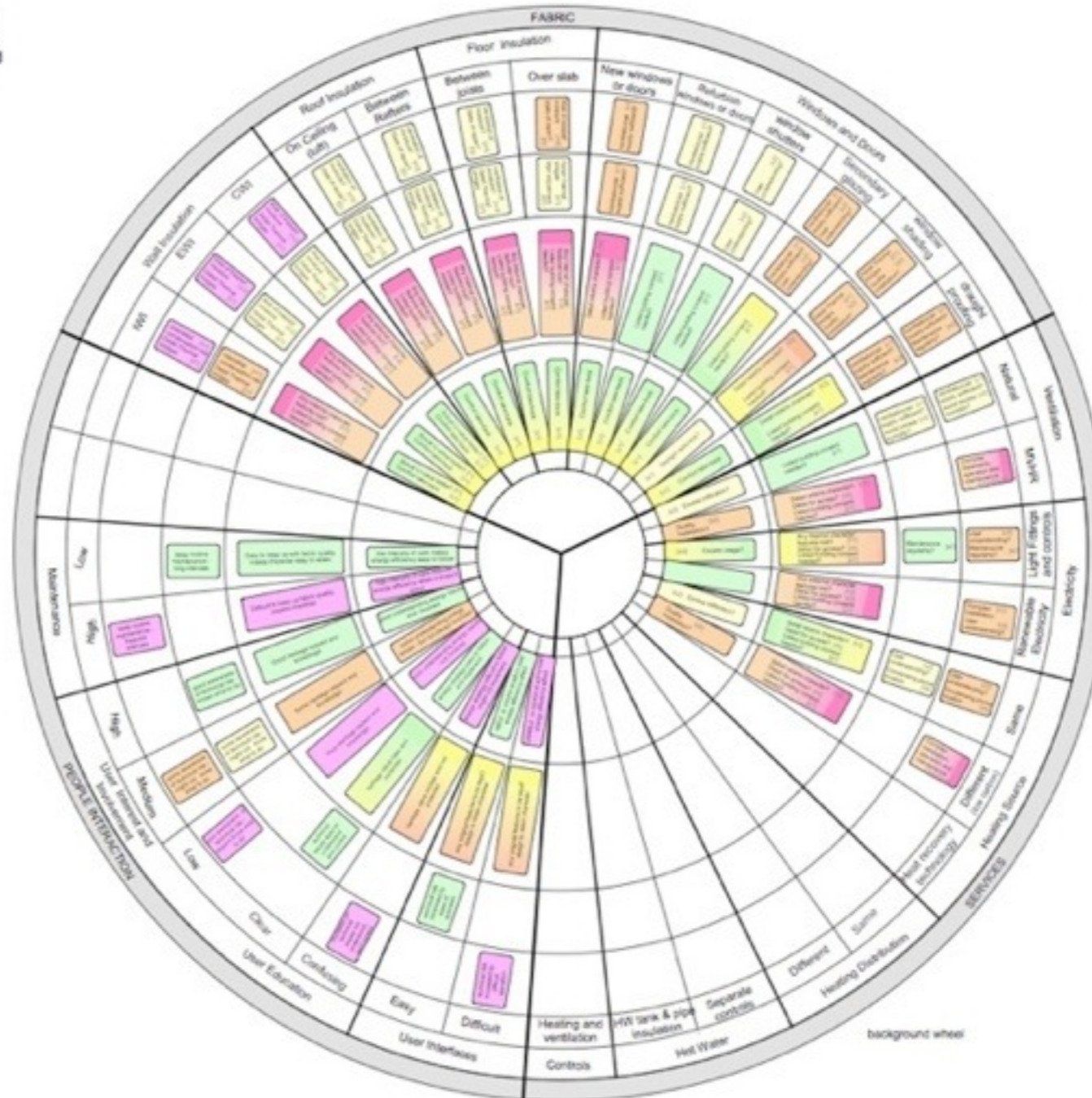
1. *Interested users (e.g. building owner)* just wanting to have an idea of the possible risks associated with possible measures.
2. *Designers or developers* wanting more detail on measures and possible interaction effects.
3. *Assessors and evaluators* keeping track of proposals.
4. *Designers or researchers* at a more detailed level looking for sources of technical guidance.

The idea #1 Starts in a shed.



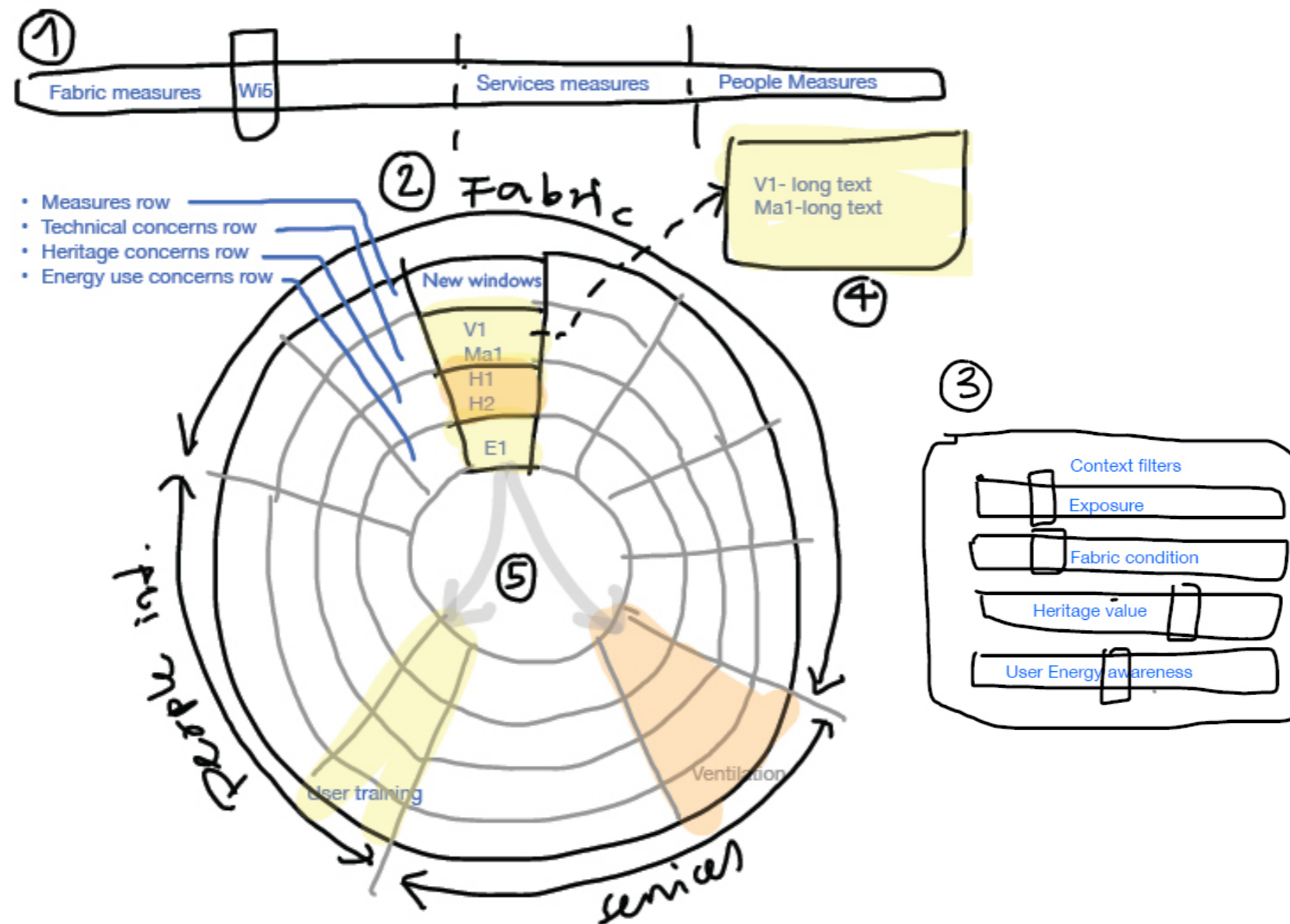
The idea #2 Physical mock-up (shows under layer)

- M** = Moisture Risk
- M¹** = Interstitial Condensation
- M²** = Moisture Ingress and/or trapped
- M³** = Moisture Out - Ventilation needed
- D** = Detail Care needed
- D¹** = Thermal Bridges
- D²** = Stair adjustment
- D³** = Detail for access
- D⁴** = Condensing plume location
- F** = Fabric uncertainty
- F¹** = Actual U-value?
- F²** = State of repair?
- V** = Ventilation sufficient?
- V¹** = Air supply for normal use
- V²** = Avoiding excess humidity
- V³** = Avoiding excess heat
- E** = Energy implication
- E¹** = Daylight reduction?
- E²** = Excess infiltration?
- E³** = Excess usage?
- A** = Aftercare needed
- A¹** = Handover to user
- A²** = Maintenance regularity
- A³** = Monitoring (and feedback)
- U** = User aspects
- U¹** = Comfort take back
- U²** = User understanding
- U³** = Space limitations



- C** = Complexity
- C¹** = complex installation
- C²** = complex operation
- C³** = complex maintenance
- H** = Heritage risk
- H¹** = Original Internal detail lost
- H²** = Original External detail lost
- H³** = Detail retains character?
- P** = Permissions needed
- P¹** = Listed Building consent
- P²** = Planning consent within conservation area
- P³** = Planning consent outside conservation area
- Q** = Quality needed
- Q¹** = Product quality
- Q²** = Installation quality
- Q³** = Commissioning quality

The idea #3 Digital concept



1. Select measure using slider bar
2. Wheel rotates to show selected measure on top segment. Other measures greyed out (but see 5 below) Technical/Heritage/Energy rows show short text Concerns and risk colour.
3. Context filters allow to adjust for various context options. Row colours adjust for context
4. On click, window with long text appears - could have links and more info?
5. Related measures are highlighted (various degrees of intensity?)

The brief #1

- Explore retrofit '*measures*' (e.g. secondary glazing) when re-fitting a traditional building.
- Highlight risks and '*concerns*' associated with such measures, in respect of:
 - technology
 - heritage
 - energy.
- Highlight possible '*interactions*' between measures.



The guidance tool is intended as a decision-making aid not as a primary information source, but may lead the user to further support content.

The brief #2

Excerpt from Design Proposal v1p1

The aim of the tool is to provide an interface for exploring:

- the measures (e.g. fit secondary glazing) available when retrofitting a traditional building
- the risks associated with measure/context combinations e.g. fitting double glazing presents heritage concerns
- the interactions between measures e.g. if draughtproofing is being considered, ventilation should be considered too

The tool must be engaging and playful and mustn't drown the user in too many technicalities. Its purpose is to educate users that retrofitting a traditional building is not a simple fix, that measures are heavily interdependent and that there is a lack of research knowledge in some areas.

Although not primarily an informational tool, ideally the tool will allow the user to find further technical content should they wish.

The brief #3

- For users:
 - Fun, encouraging inquisitive exploration.
 - Several 'levels', for different interests and abilities.
 - Instantaneous and useful outputs.
- For those managing the inputs to the background databases:
 - Straightforward to update, with minimal likelihood of input error.
 - Changes cascade automatically to the user interface without need for re-programming.

The brief #4

- For the programmer:
 - A challenge at the cutting edge of graphics.
 - Using ...
 - Browser-based, ‘client-side’ implementations
 - Potential of D3/Javascript and Scalar Vector Graphics (SVG)
- For everyone:
 - “A journey from details to value and back”.
- For STBA/DECC:
 - Communicating complex information responsibly and even-handedly.

The brief #5

- *Measures* available for retrofitting traditional buildings
 - E.g. Walls and their sub-types e.g. internal wall insulation
- *Risks/concerns* associated with interventions
 - E.g. for Technical, Heritage and Energy, coded red amber, yellow, green
- *Interactions* between measures
 - E.g. internal wall insulation and window shutters
- *Context* for the above.
 - E.g. Condition and state of repair, orientation

A traditional building is ...

“a property built prior to 1919 with solid walls constructed of moisture-permeable materials”

- Sustainable Traditional Buildings Alliance, Responsible Retrofit Report, and Approved Document Part L1B definition.

Version 1p3

RESPONSIBLE RETROFIT GUIDANCE WHEEL

STBA
SUSTAINABLE TRADITIONAL BUILDINGS ALLIANCE

BEHAVIOUR

People Interaction

Technical concerns

Heritage concerns

Energy concerns

Wall

Roof

Floor

FABRIC

Windows

Doors

Chimney

Electricity Gen...

SERVICES

Heat Generation

Hot water Storage

Heat Distribution

Lighting

Ventilation

Reset wheel

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Colour key

Building context

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Conservation area (Building in conservation area)

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Fair (Acceptable condition, likely to need some sm)

Exposure

What is the exposure of the building to wind driven rain? (see B.Regs AD C diagram 12 shows map for UK zones). Apply correction factors if known and as described in BS 8104:1992

Moderate (Wind driven rain (in l/m2 per spell) 33 t)

Energy User Type

How does the energy user compares with others in terms to energy use as assessed in the Green Deal Occupancy assessment?

Medium (Typical) Energy Use (Within 20% either sic)

User interest and involvement In Operation

What is the user's level of motivation and knowledge when operating the building?

Uninterested User

Number of exposed sides

How many sides of the building are exposed to wind for ventilation?

Single (Dwelling has a single exposed side)

RESPONSIBLE RETROFIT GUIDANCE WHEEL

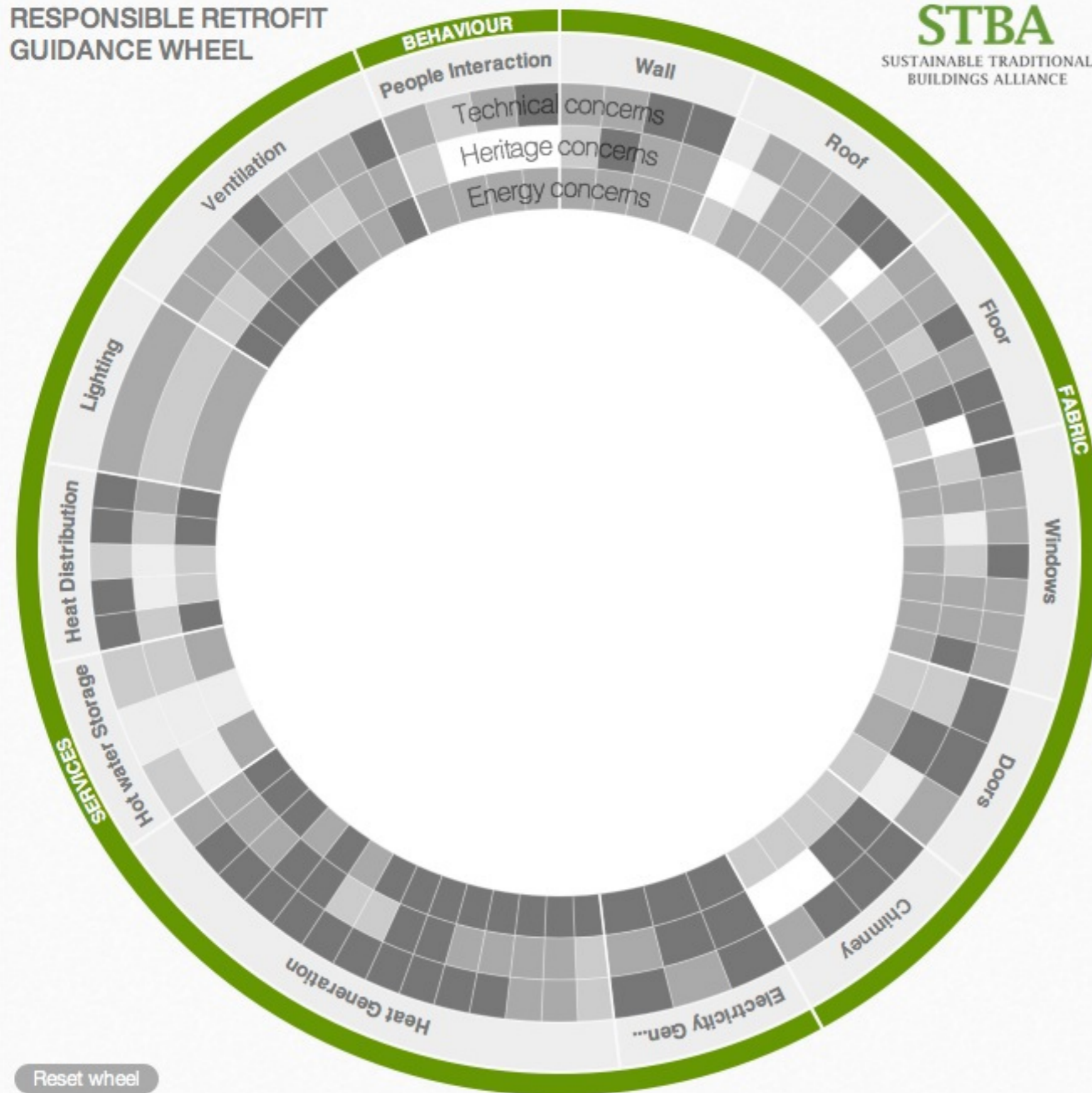
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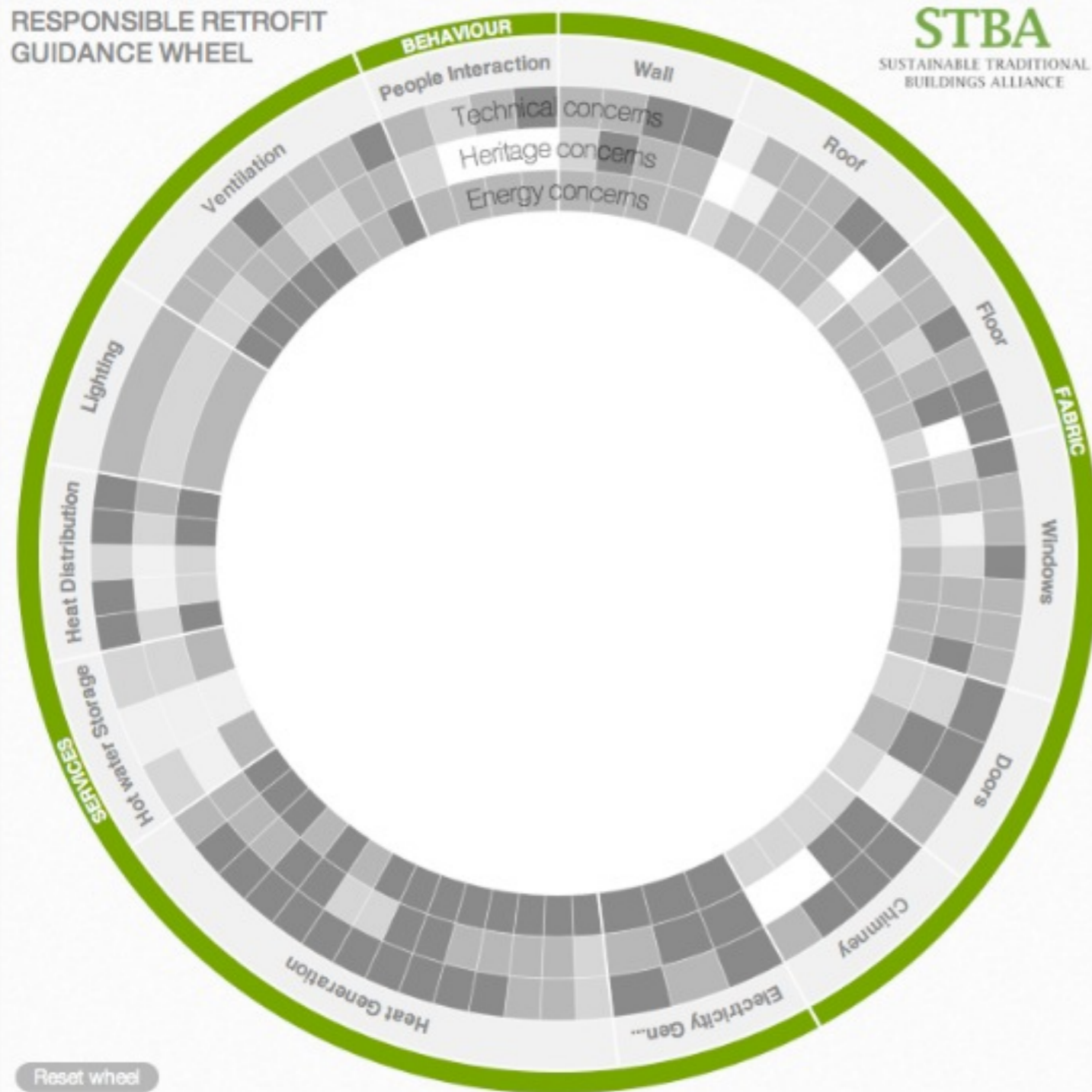
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▼ Building context

Please select the context of your building here:

- Listed – Exceptional (Listed building – Grade 1 and 2* in E&W, Category A in Scotland and NI)
- Listed – Important (Listed – Grade 2 in E&W, Category B and C(S) in Scotland and B and B+ in NI)
- ✓ Conservation area (Building in conservation area)
- Character building (Building with some character but not in a conservation area)
- Non character building (Building heritage character not significant)

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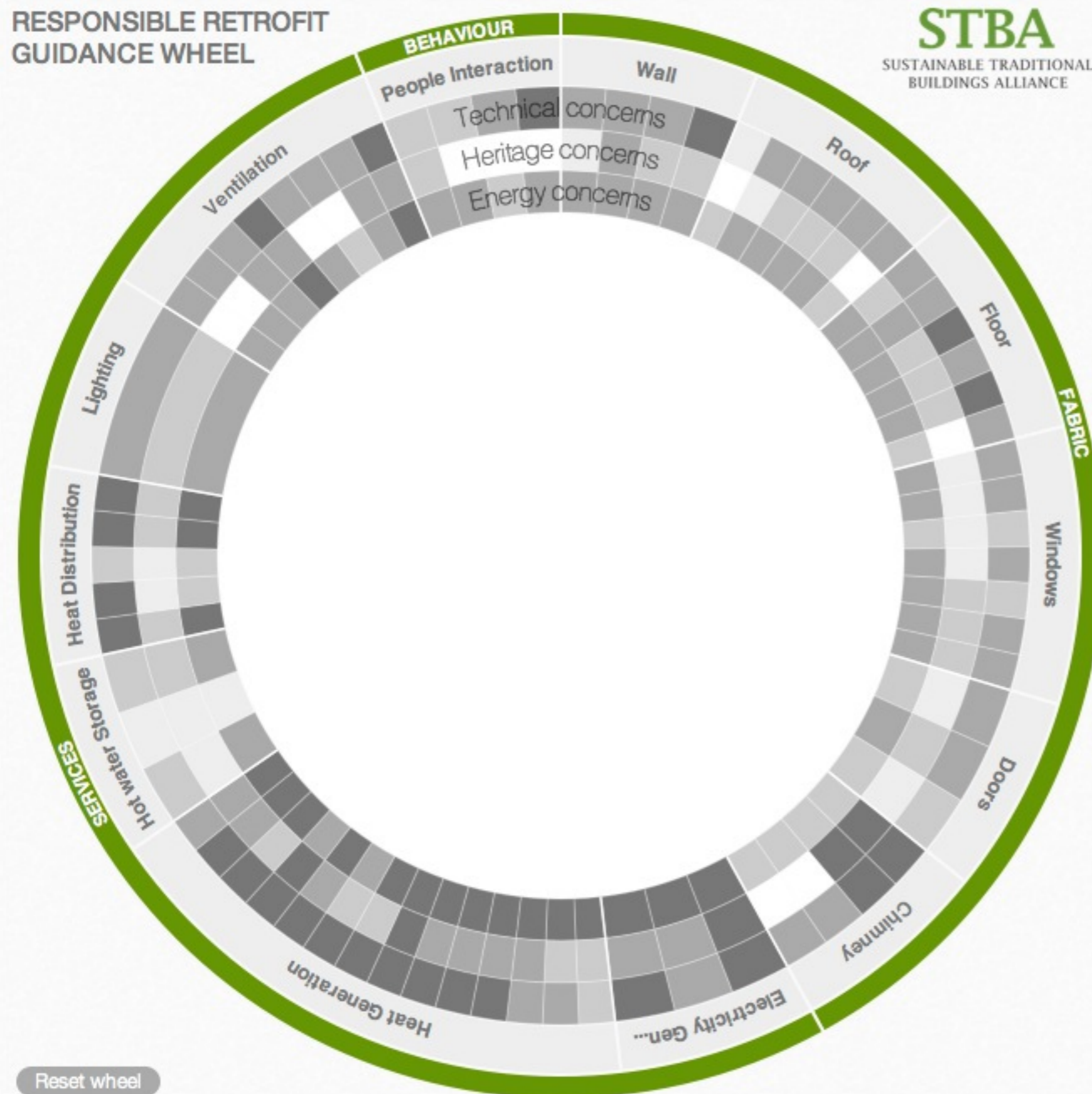
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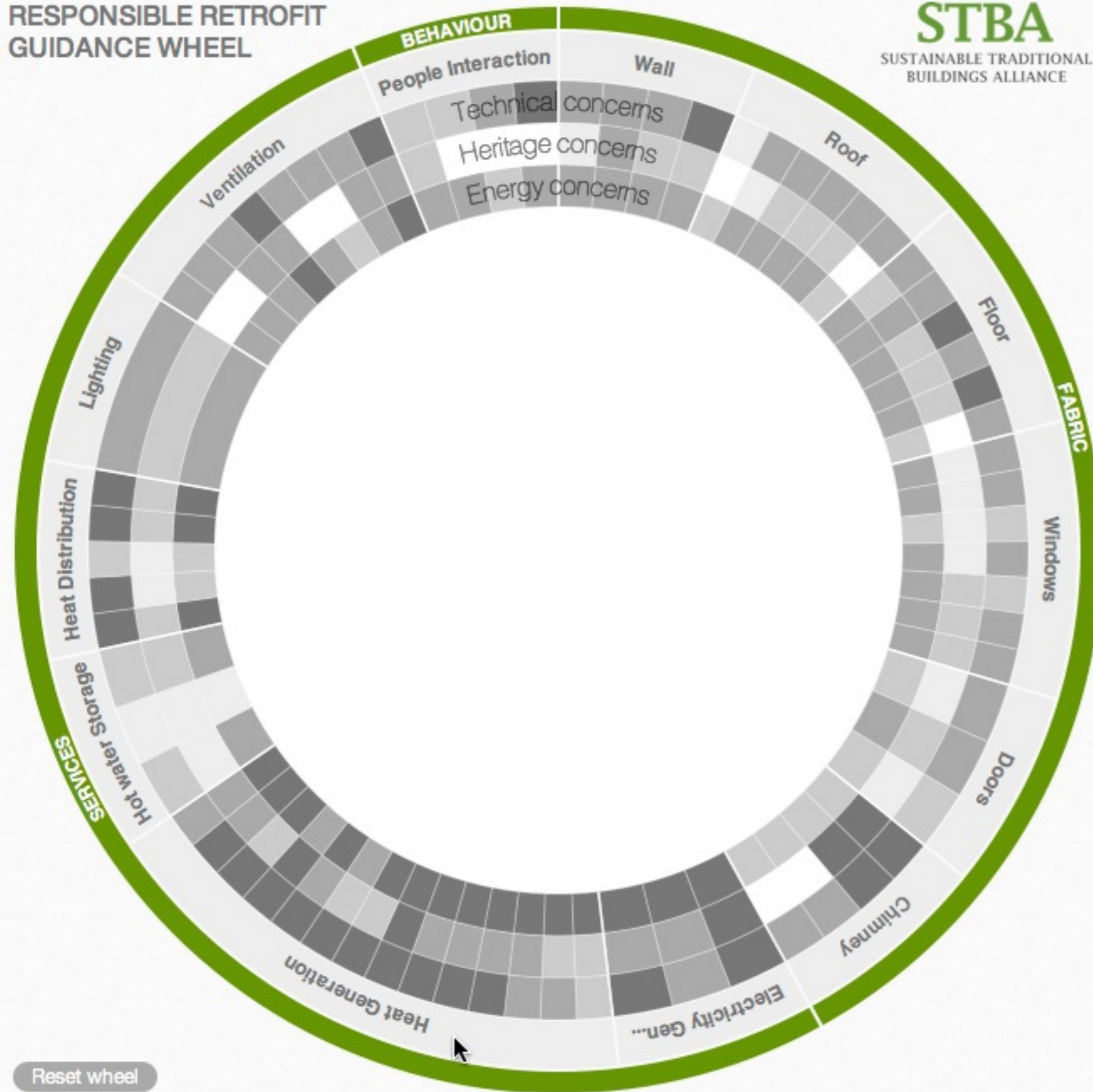
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Heat Generation

Heat generation measures look at options to improve the efficiency of the heating system by either refurbishment of existing, introducing heat recovery devices, installing a new model to current efficient standards, looking at alternative low carbon and renewable heat generation sources or considering multiple building heat generation.

Heating system Refurbishment

High efficiency gas-fired condensing boilers

Oil-fired condensing boilers

Air source heat pumps

Ground/Water source heat pumps

Biomass boilers

Biomass stove with back boiler

Fan-assisted replacement storage heaters

Flue gas heat recovery devices

Solar water heating

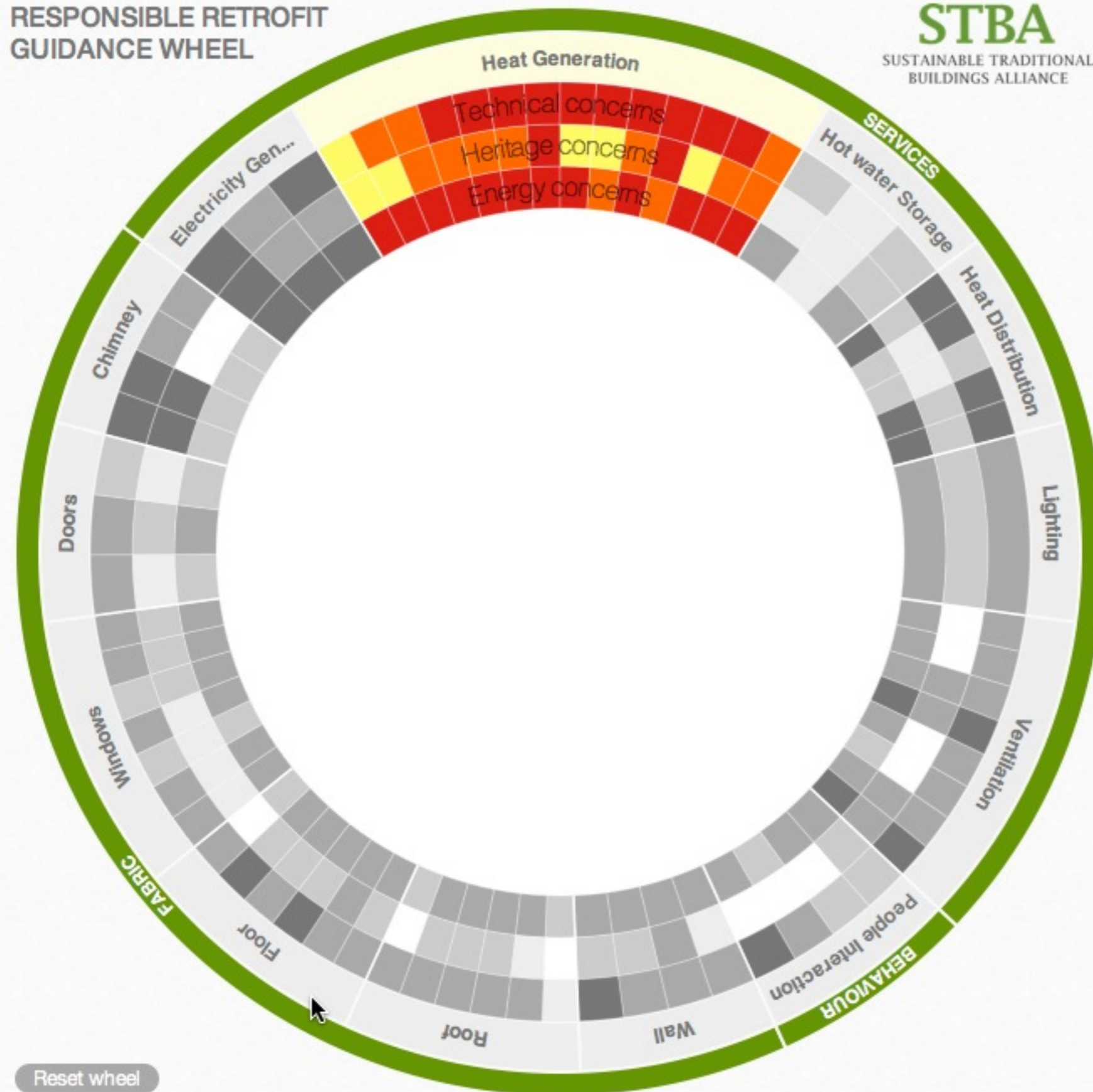
Waste water heat recovery devices for showers

Communal heat generating system

Micro combined heat and power

High efficiency replacement warm-air units

CLOSE CATEGORY



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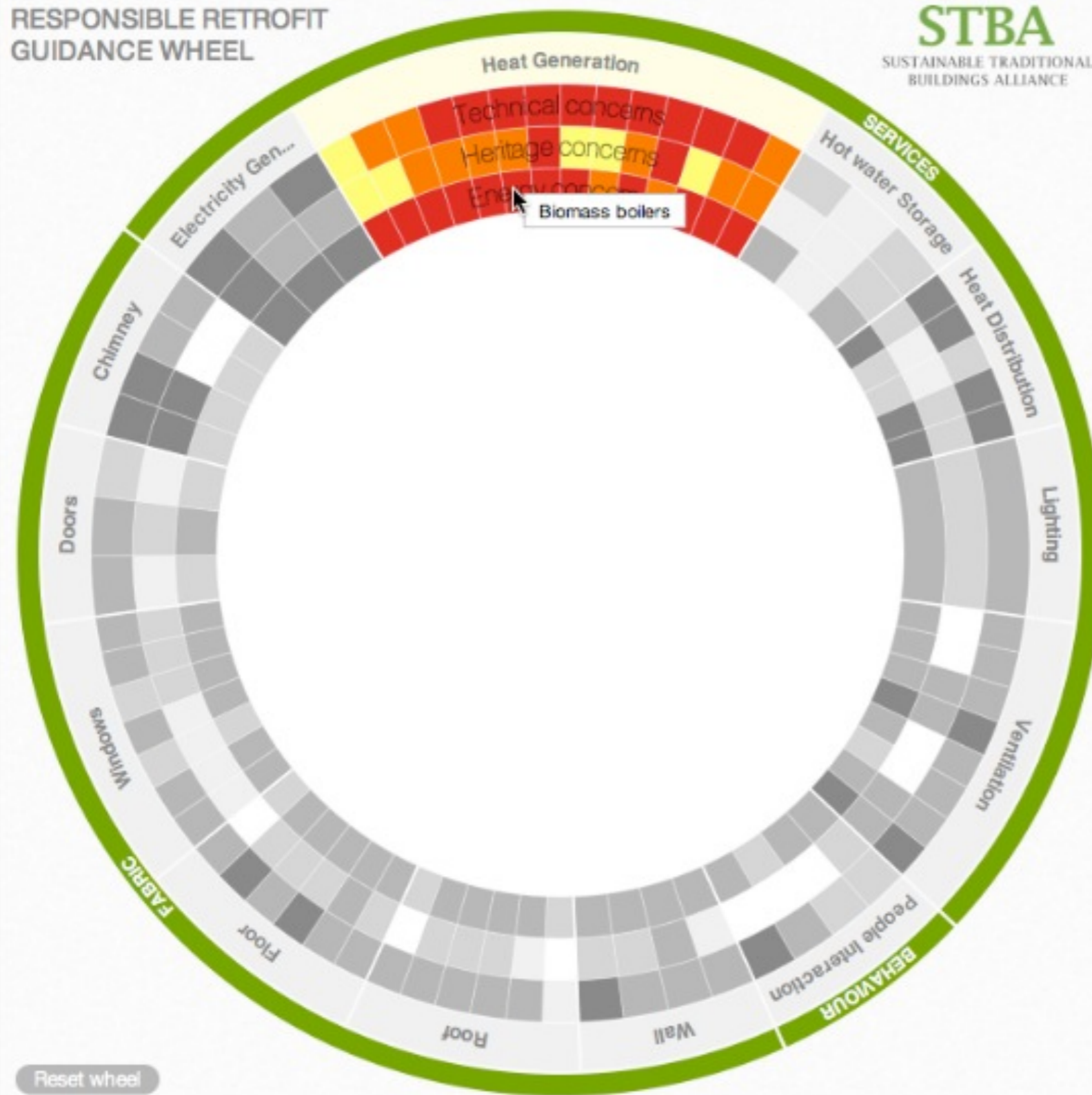
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CLOSE CATEGORY

Reset wheel

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Heat Generation

Biomass boilers

Installation of large scale biomass boiler (woodchip, woodlogs or pellets) to provide heating and hot water.

ADD TO LISTCLOSE MEASURE

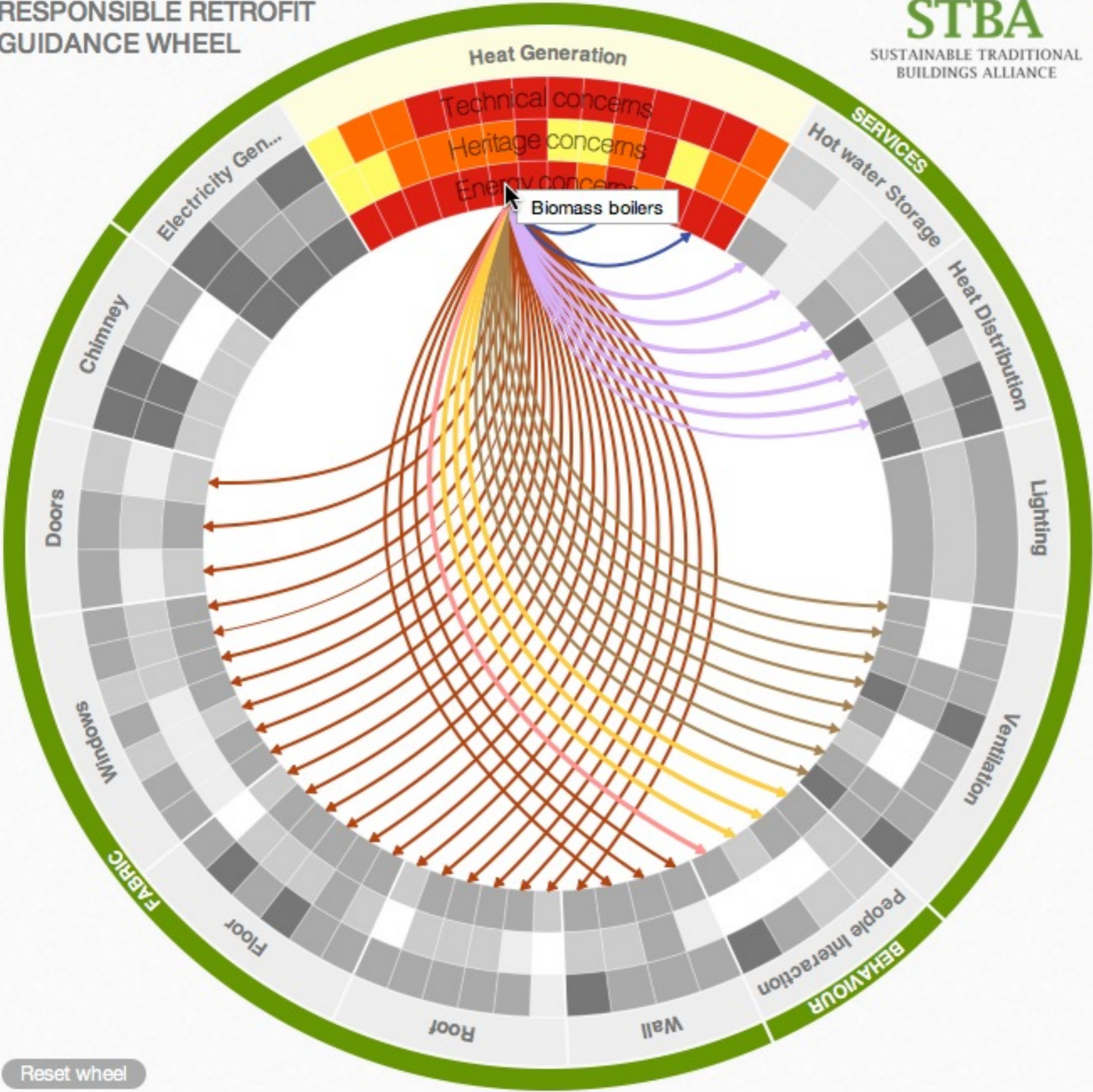
► Advantages

► 7 Technical Concerns

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► 5 Energy Concerns

► Related measures



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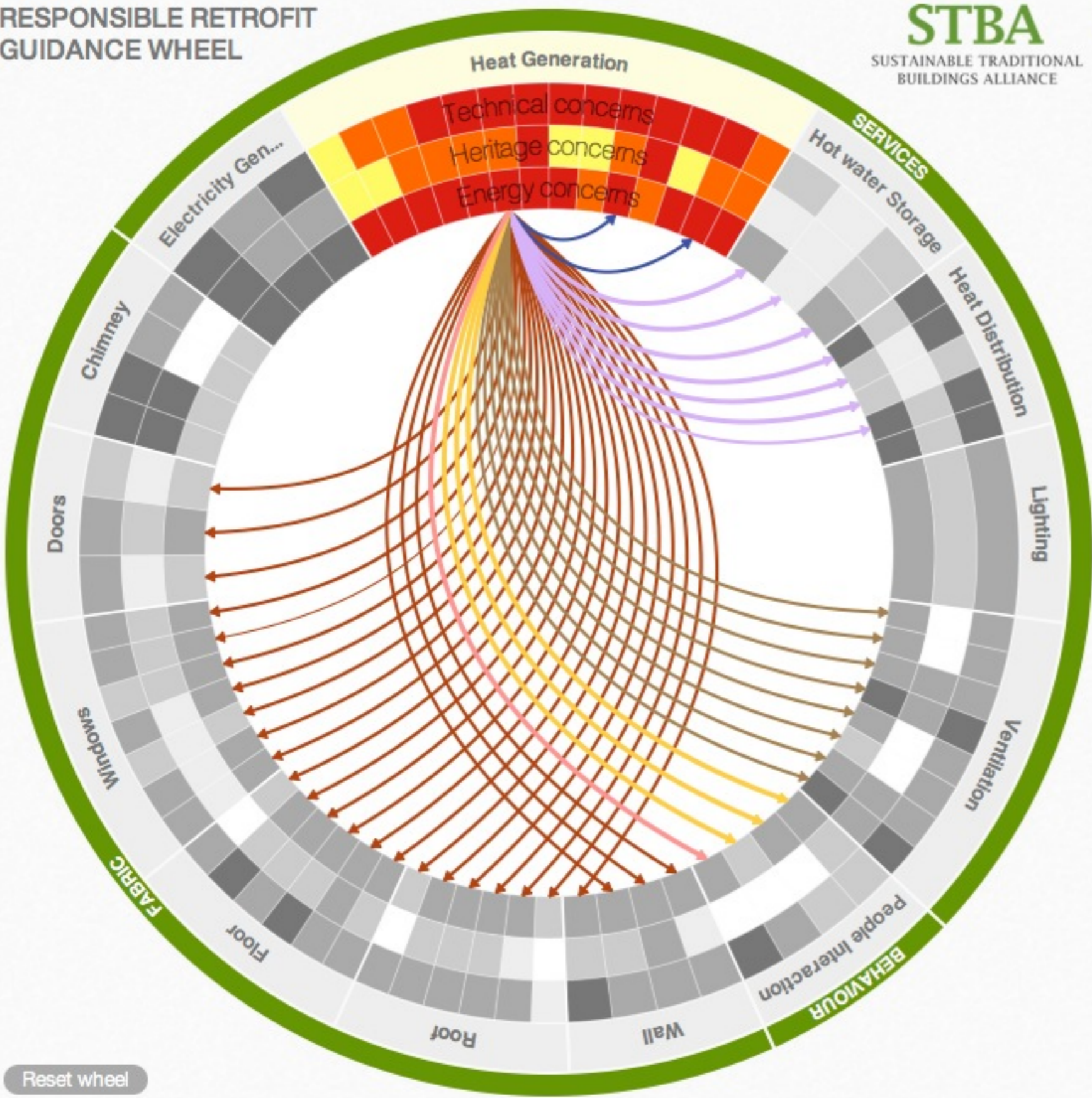
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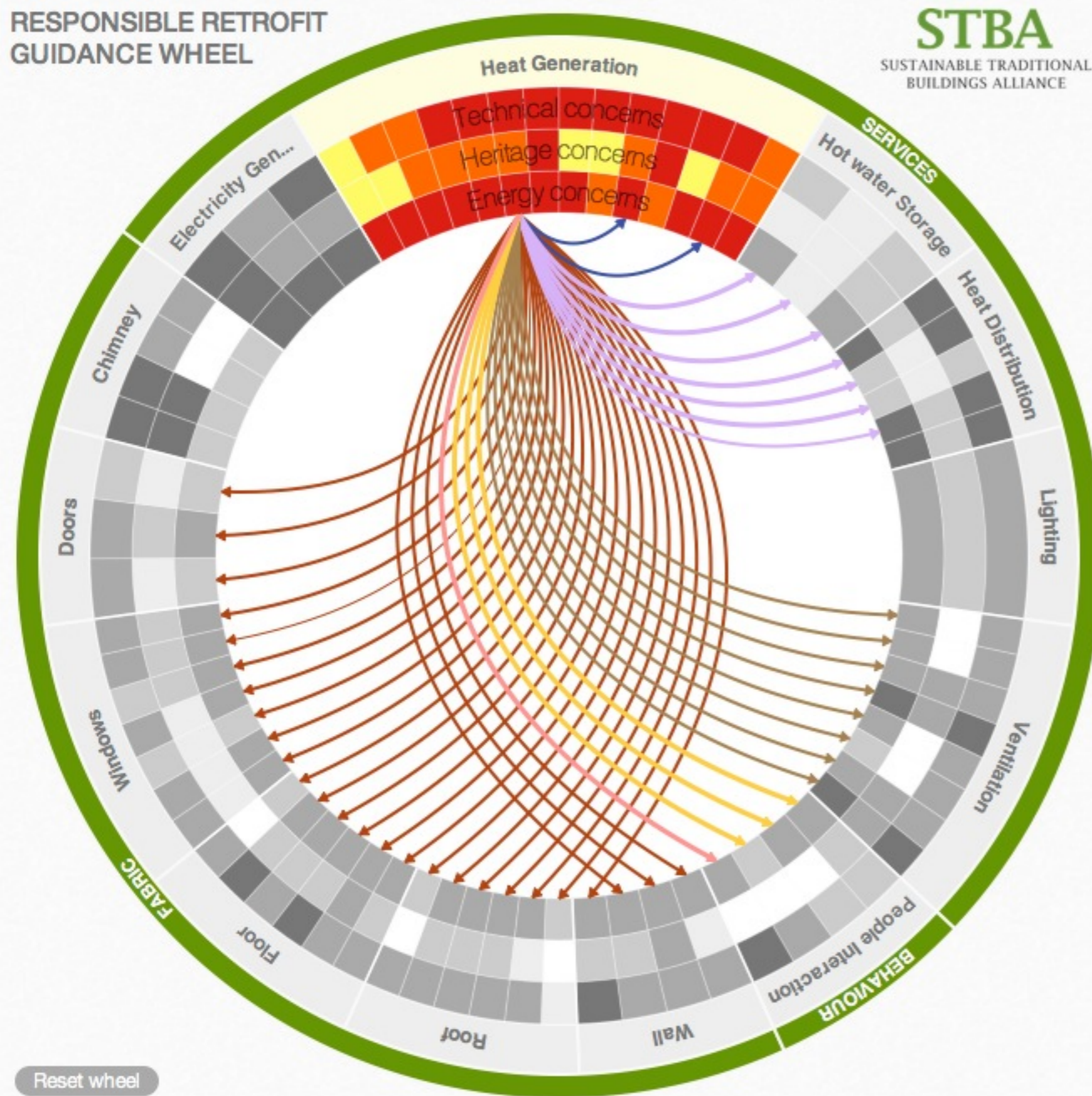
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Colour key

Concerns

- Minor concern
- Medium concern
- High concern
- Major concern

Measure to measure linkages

- Measure options
- Thermal coherence
- Airtightness
- Human Health/Fabric Health
- Heating issues
- People issues
- Monitoring and maintenance
- Hidden services
- Electricity issues

Building context

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Installation of large scale biomass boiler (woodchip, woodlogs or pellets) to provide heating and hot water.

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... supporting www.usablebuildings.co.uk

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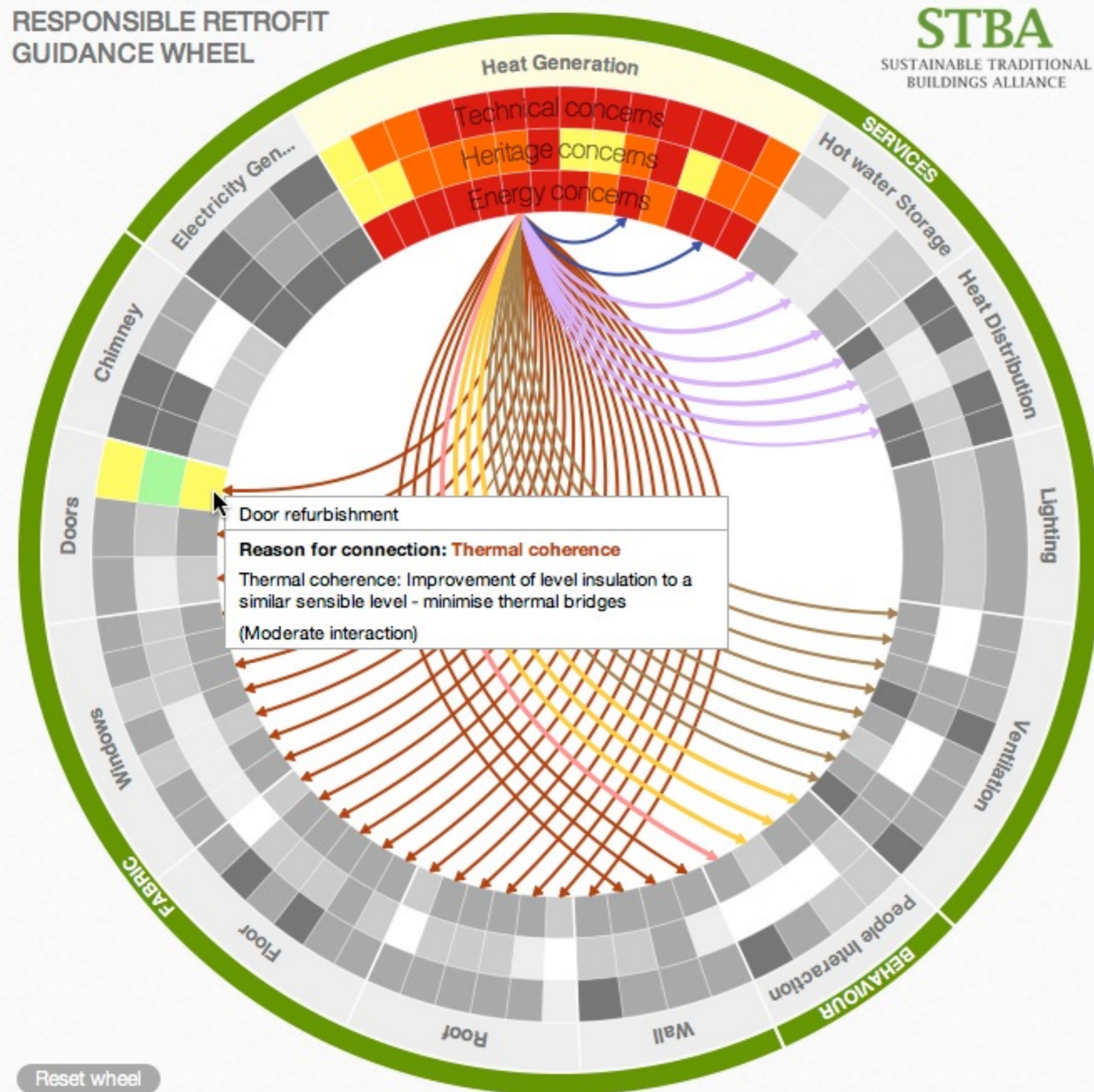
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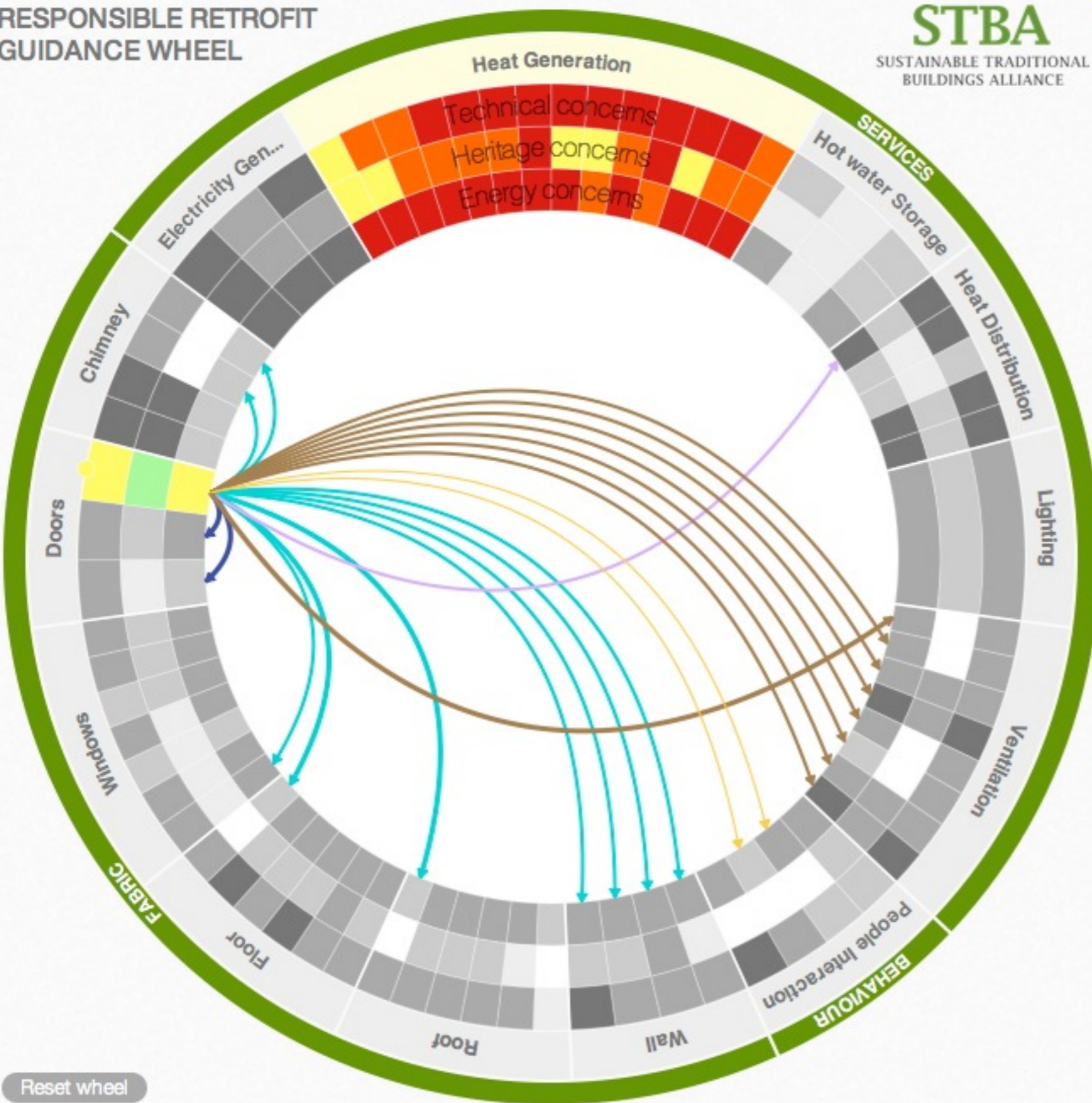
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Building context

Doors

Door refurbishment

Repair of existing doors to make operational and tight fitting.

REMOVE FROM LIST

CLOSE MEASURE

Advantages

4 Technical Concerns

2 Heritage Concerns

- Planning consent outside conservation area (minor)
- Detail retains character? (minor)

Chosen measures

Door refurbishment

Repair of existing doors to make operational and tight fitting.

Advantages

Good repair ensures that original door can be retained; some improvement in air-tightness may be achieved

Technical concerns:

Sufficient ventilation? (medium) Overheating (medium) Monitoring and feedback required (medium) Personal capacity/Right opportunity (medium)

Heritage concerns:

Planning consent outside conservation area (minor) Detail retains character? (minor)

Energy concerns:

Rebound effects (medium)

Concerns

Medium risks

Sufficient ventilation?

Measures raising this concern: Door refurbishment

Adequate ventilation is needed for the occupants in a building and for the protection of the building fabric in normal circumstances. Some measures can reduce the existing air permeability and make necessary additional ventilation. In addition, Certain activities (e.g. cooking, showering/bathing, drying clothes) create high moisture loads. Appropriate active ventilation system are needed to remove this excess moisture. Otherwise significant localised moisture problems can occur.

Suggested actions (before)

Monitor and measure existing room and fabric moisture conditions pre refurbishment. Assess existing ventilation provision and weigh up ventilation strategy options post refurbishment to address proposed increased airtightness. Take into consideration household size and occupancy pattern. Establish ventilation strategy to provide adequate ventilation in line with AD Part F, including air provision for occupants in the building and adequate ventilation at points of moisture generation within building (bathroom, kitchen, utility and other wet rooms). Beware of personal preferences that may override optimum system settings. Decide on operation strategy and balance the need for good user understanding and automation of the ventilation system. Consider good information and user interaction may be best for lower risk levels

Suggested actions (during)

Physically test the installed ventilation system capacity to confirm design criteria given in AD part F is met. Communicate the ventilation strategy to occupants clear and simply and check they understand it. Beware of personal preferences that may override optimum system settings.

Suggested actions (after)

Monitor indoor air quality post refurbishment and report results. Monitor room and fabric moisture conditions and report findings. Carry out regular visual checks for damp patches and mould growth in vulnerable areas (kitchen, bathrooms)

References

CASE STUDY **RESEARCH** [Tech Paper 6 - Indoor Air Quality and Energy Efficiency in Traditional Buildings](#) (2009) Halliday, S., (Gaia Research)

GUIDANCE [Warmer Bath: A guide to improving the energy efficiency of traditional homes in the city of Bath](#) (2011) Bath Preservation Trust & Centre for Sustainable Energy

CASE STUDY **RESEARCH** [The Performance of Traditional Buildings: the SPAB Building Performance Survey 2013](#) (2013) Rye, C, Scott C & Hubbard, D.

GUIDANCE [Energy Efficiency In Historic Buildings - Draught-proofing windows and doors](#) (2010) English Heritage

GUIDANCE [Energy Efficiency In Historic Buildings -Secondary glazing for windows](#) (2010) English Heritage

GUIDANCE [Improving Energy Efficiency in Traditional Buildings](#) () Historic Scotland

CASE STUDY **RESEARCH** [Future Fit: Installation Phase in depth findings](#) (2011) EST/Affinity Sutton

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Overheating

Measures raising this concern: Door refurbishment

High temperatures in buildings can cause discomfort and ill health. Fabric energy efficiency measures can exacerbate problems (e.g. by changing thermal mass, increasing thermal resistance and reducing ventilation). Services can also increase heat loads.

Suggested actions (before)

Consider strategy for building to deal with higher temperatures (e.g. shading, thermal mass, purge night ventilation, planting). Ensure effective ventilation is possible, i.e. cross ventilation, and check that existing window opening and shading opportunities are not compromised by additional measures. Beware that personal preference may override optimum settings for system. Decide on operation strategy and balance the need for good user understanding and automation of the system. Consider good information and user interaction may be best for lower risk levels

What next ...?

Case studies?

Misunderstanding 1: General, theoretical (context-independent) knowledge is more valuable than concrete, practical (context-dependent) knowledge.

Misunderstanding 2: One cannot generalize on the basis of an individual case; therefore, the case study cannot contribute to scientific development.

Misunderstanding 3: The case study is most useful for generating hypotheses; that is, in the first stage of a total research process, whereas other methods are more suitable for hypotheses testing and theory building.

Misunderstanding 4: The case study contains a bias toward verification, that is, a tendency to confirm the researcher's preconceived notions.

Misunderstanding 5: It is often difficult to summarize and develop general propositions and theories on the basis of specific case studies.

Five Misunderstandings About Case-Study Research

Bent Flyvbjerg

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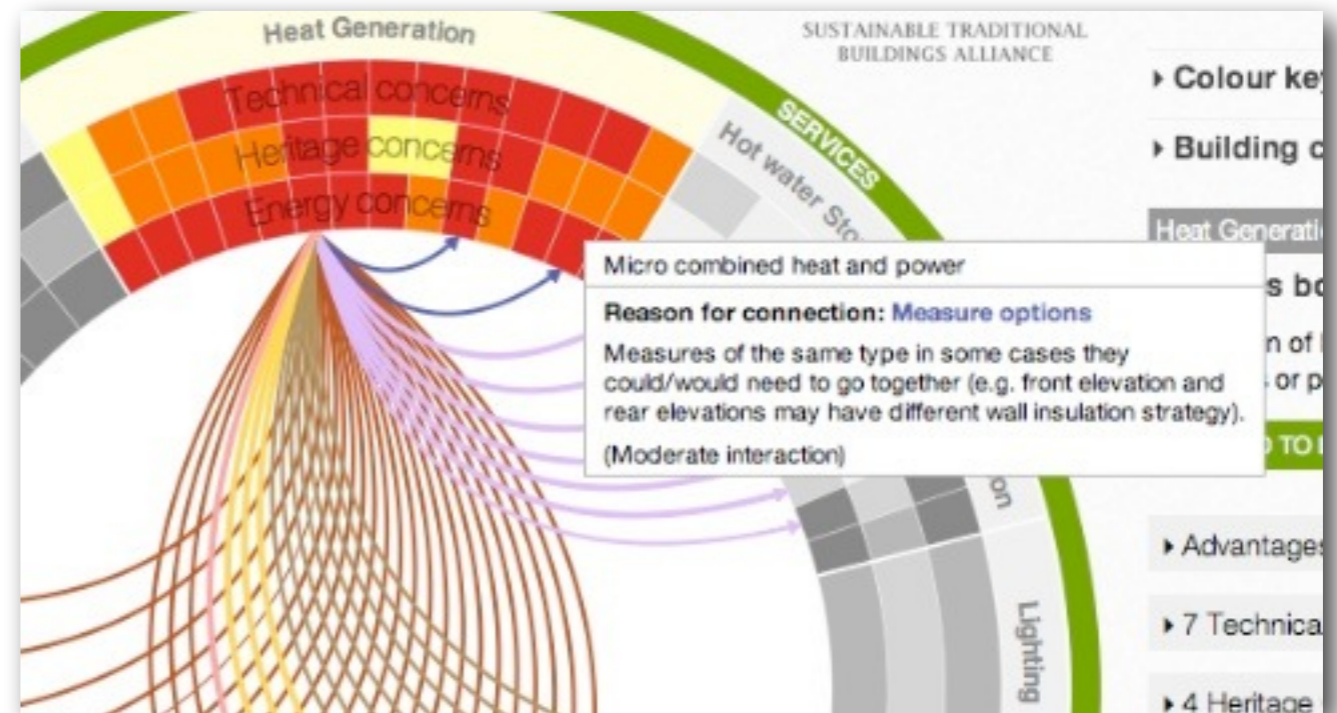
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So ... ?

- Case studies with careful attention to context and systemic properties ...
- With tried-and-tested survey methods using established protocols where appropriate.
- Exceptions/outliers/curiosities often of more interest than norms/medians/received wisdom. *Canaries in the mine.*
- Care needed with survey curation and presentation to build audience confidence and avoid bias.
- Results can be surprising, so shoot-the-messenger, decry-the-method and bury-the-bad-news often come before objective assessment of findings and diagnostics.

Structure cases on linkage outcomes ...?



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